

EGU2020-2672

<https://doi.org/10.5194/egusphere-egu2020-2672>

EGU General Assembly 2020

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



Experimental constraints on mylonite formation

Philip Skemer¹, Caroline Bollinger¹, Andrew Cross², and Helene Couvy¹

¹Washington University in St. Louis, St. Louis MO, United States of America (pskemer@wustl.edu)

²Woods Hole Oceanographic Institute, Woods Hole MA, United States of America

Mylonites are ubiquitous structural features of dynamic plate boundaries, and are widely assumed to represent the product of localized deformation at high pressure and temperature. There are two features of mylonites that distinguish them from typical host rocks: grain-sizes that may be reduced by orders of magnitude and mineral phases that generally well-mixed. Together, these microstructural characteristics are thought to promote rheological weakening over long geologic intervals, an essential feature of Earth-like plate tectonics. In this contribution we describe experiments that seek to reproduce deformation processes and resulting microstructures that occur during mylonitization. Experiments were conducted at high pressure (1-2 GPa) and temperature (500-750 C) on dense synthetic composites of calcite (Ca) and quartz (Qz), anhydrite (An), or fluorite (Fl). These composites were selected to investigate the influence of viscosity contrast on the phase mixing process. Shear strains of $\gamma > 50$ were produced using the Large Volume Torsion Apparatus (LVT) at Washington University in St. Louis. Ex situ microstructural analysis was performed with optical microscopy, SEM, EBSD, and TEM. Experiments are interpreted to have deformed by either viscoplastic (Ca+Fl and Ca+An) or semi-brittle mechanisms (Ca+Qz). We show that the evolution of the protolith towards recrystallized and well-mixed microstructures occurs over a large range of shear strains. The critical strain depends on the mechanism of mixing, the viscosity contrast between the two phases, and the microstructure of the starting material. Phase mixing is determined to be the product of several independent mechanisms, the relative importance of which depends on pressure, stress, strain, composition, viscosity contrast, and the ratio of the initial grain-size to the recrystallized grain size.